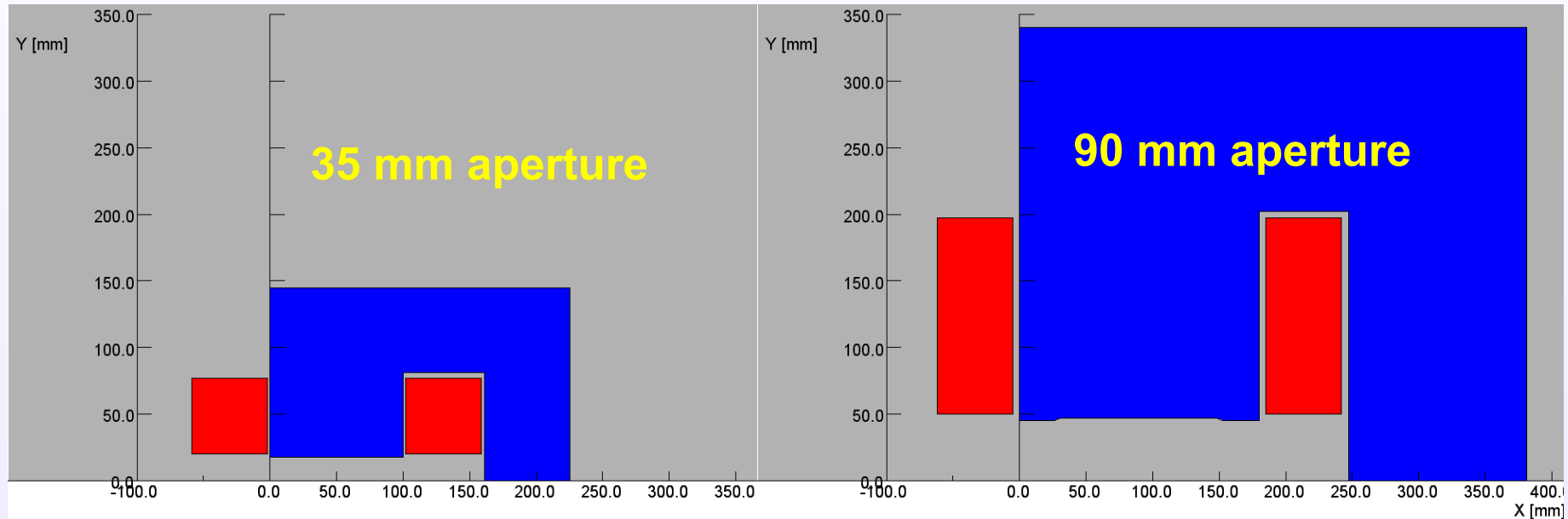


Preliminary 2-d and 3-d Designs of 90 mm Dipole

Ramesh Gupta

Comparison of 35 mm and 90 mm Aperture Dipoles

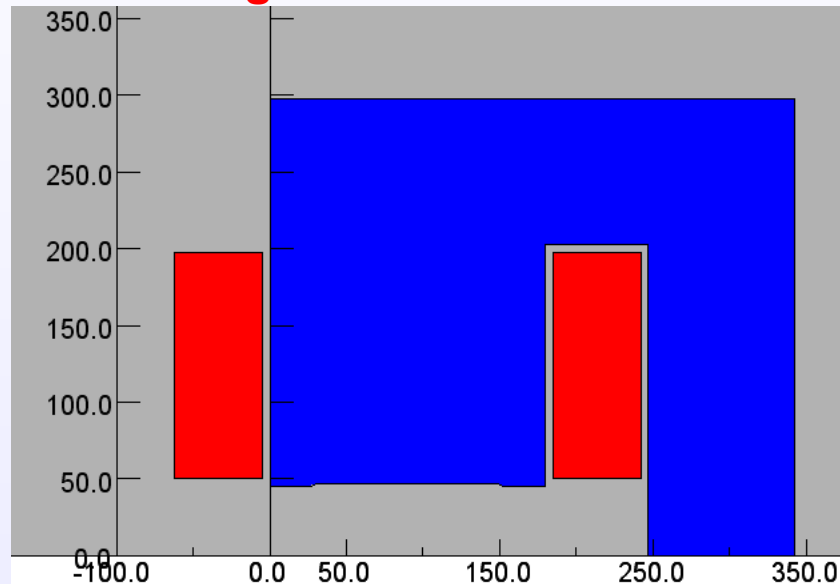


- Same conductor is chosen as in 35 mm dipole. The number of turns are adjusted.
- No. of turns: 16 (4 X 4) in 35 mm aperture and 40 (4 X 10) in 90 mm aperture.
- Make transfer function of this dipole of two dipoles similar (???) with a maximum ~1% deviation (???)

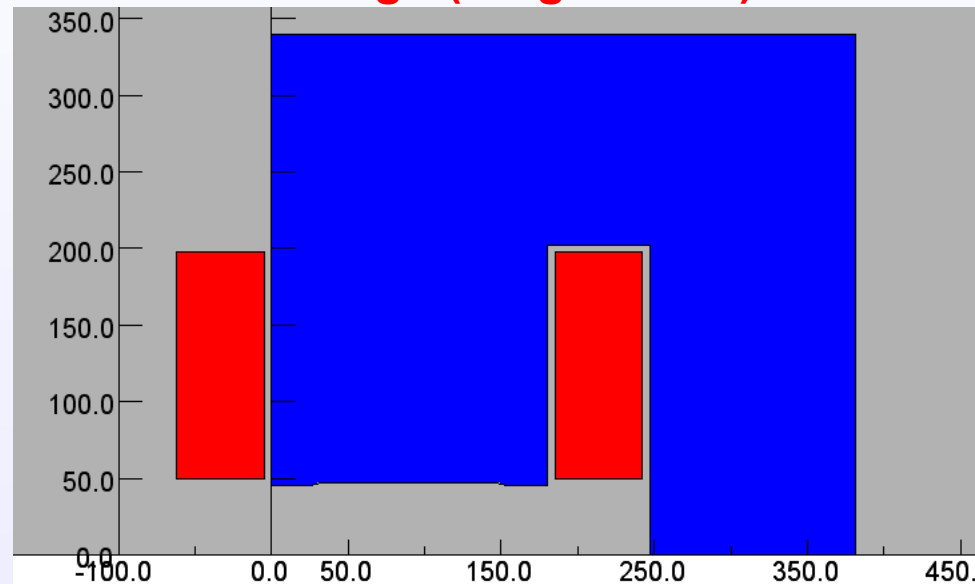
Note: 90 mm is a nominal aperture if the two magnet runs on same power supply.
Adjust aperture to match transfer function better in the same power supply case.

Preliminary 2-d Design of ~90 mm Dipole

Design Presented Last Week



New Design (Larger Yoke)



- Yoke size increased due to mechanical concern.
- More increase (cost) should wait for mechanical analysis.

Both designs meet the following stated requirements:

- Nominal Field – $B_0 = 0.40\text{T}$ to 0.50T
- Field Homogeneity $B_X, B_Y = 1 \times 10^{-4}$
- Good field region $B_X \pm 20\text{mm}$, $B_Y \pm 10\text{mm}$
- Nominal Current density in the coil cross section 2 Amps/mm^2

Yoke Design

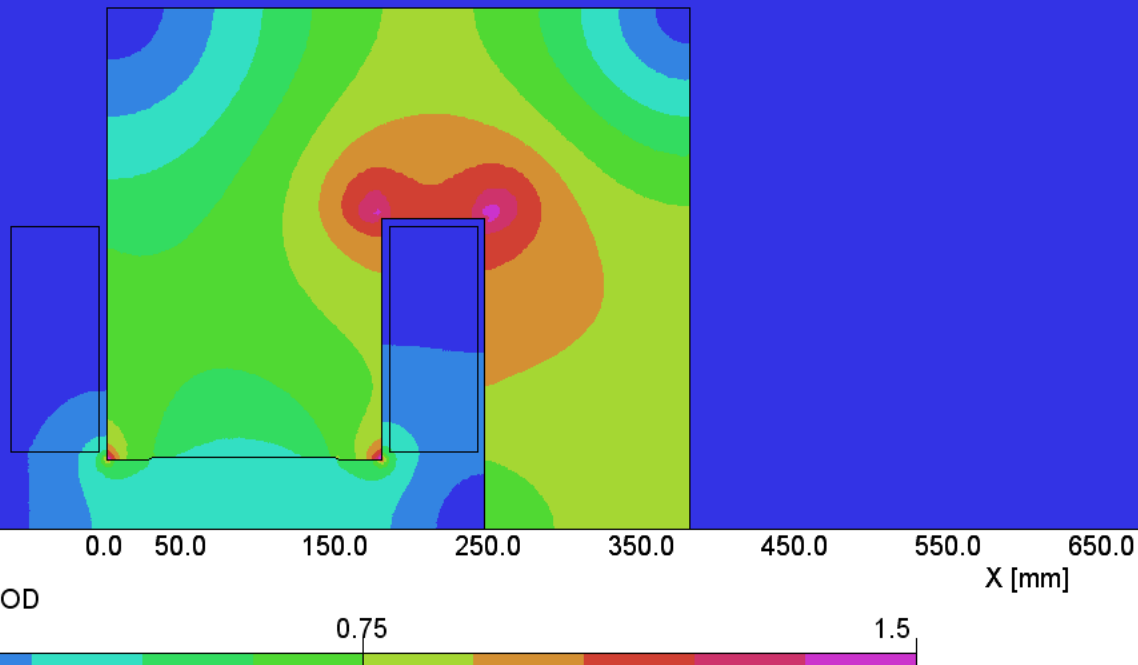
The maximum field in the yoke is 0.8 T for 0.4 T central field.
Therefore, the need for an increase in yoke size must be justified on mechanical ground.

UNITS	
Length	: mm
Flux density	: T
Field strength	: A m ⁻¹
Potential	: Wb m ⁻¹
Conductivity	: S m ⁻¹
Source density	: A mm ²
Power	: W
Force	: N
Energy	: J
Mass	: kg

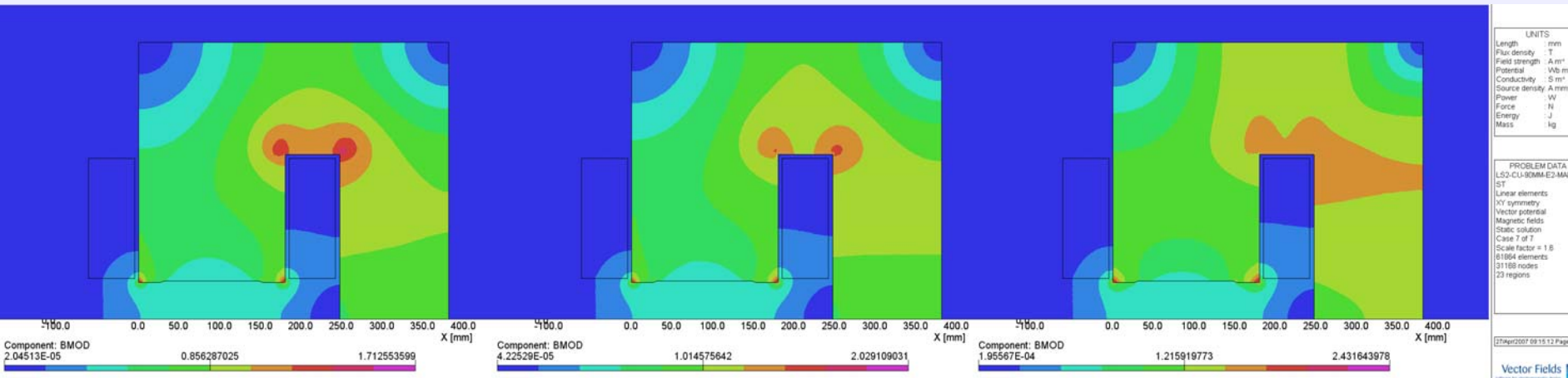
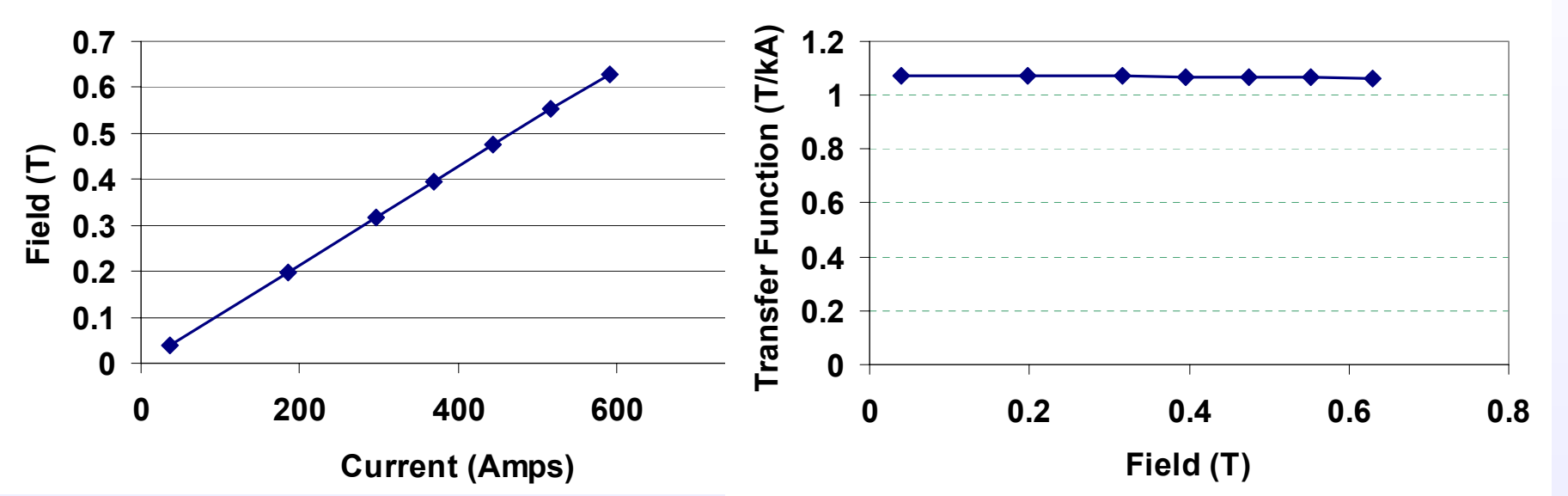
PROBLEM DATA
E:\opera\ls2\90mm\ls2-cu
-90mm-e2.st
Linear elements
XY symmetry
Vector potential
Magnetic fields
Static solution
Scale factor = 1.0
61864 elements
31188 nodes
23 regions

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Vector Fields
software for electromagnetic design



**Iron Saturation in
90 mm Aperture Dipole**

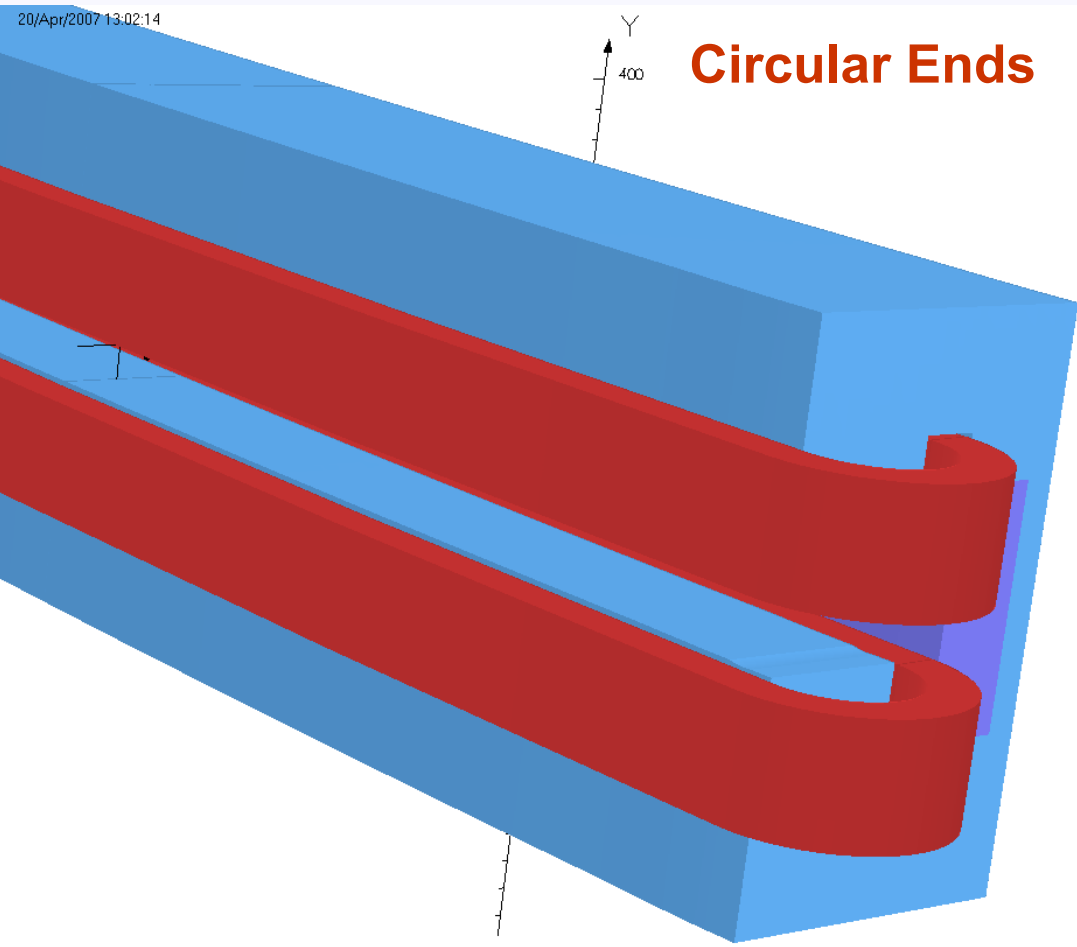


Design field

20% over the design field

60% over the design field

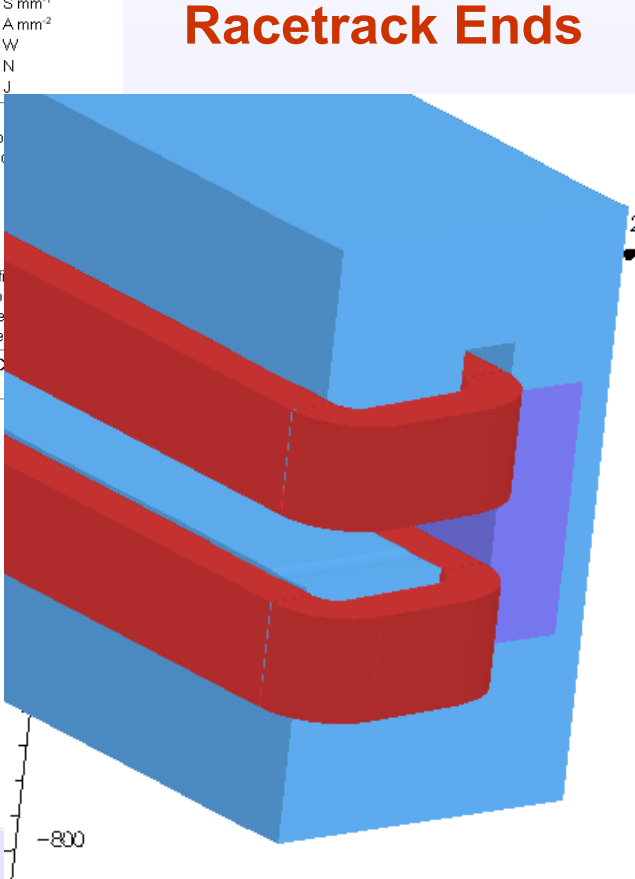
Preliminary 3-d Analysis of ~90 mm Aperture Dipole



Circular Ends

UNITS	
Length	mm
Magn Flux Density	T
Magn Field	A m ⁻¹
Magn Scalar Pot	A
Magn Vector Pot	Wb m ⁻¹
Elec Flux Density	C m ⁻²
Elec Field	V m ⁻¹
Conductivity	S mm ⁻¹
Current Density	A mm ⁻²
Power	W
Force	N
Energy	J

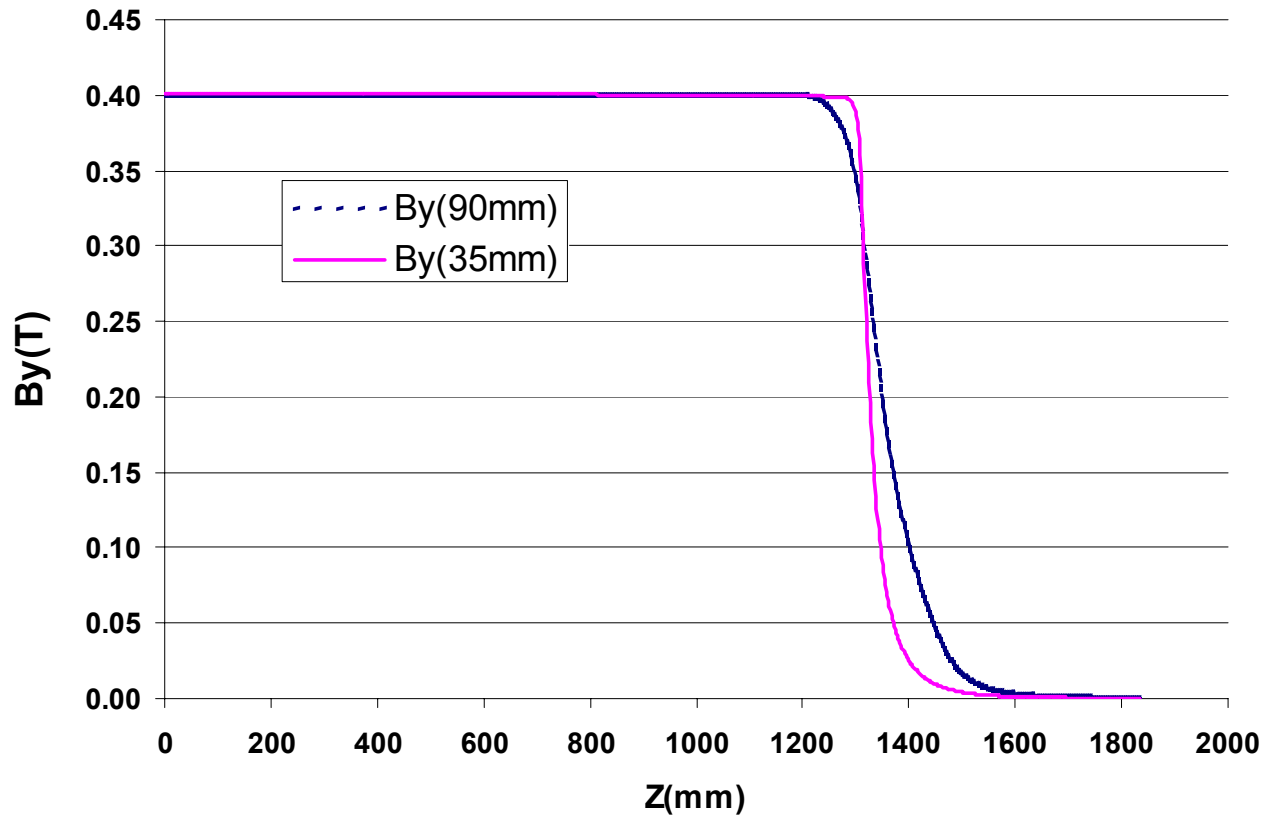
PROBLEM DATA
race-90mm-a1w_4T.o
TOSCA Magnetostatic
Nonlinear materials
Simulation No 1 of 1
5459068 elements
917946 nodes
3 conductors
Nodally interpolated fields
Activated in global coordinate system
Reflection in XY plane
Reflection in ZX plane
Field Point Local Coordinate System
Local = Global



Racetrack Ends

Vector Fields
software for electromagnetic design

Comparison of Axial Field Profile of 90 mm and 35 mm Aperture Dipoles

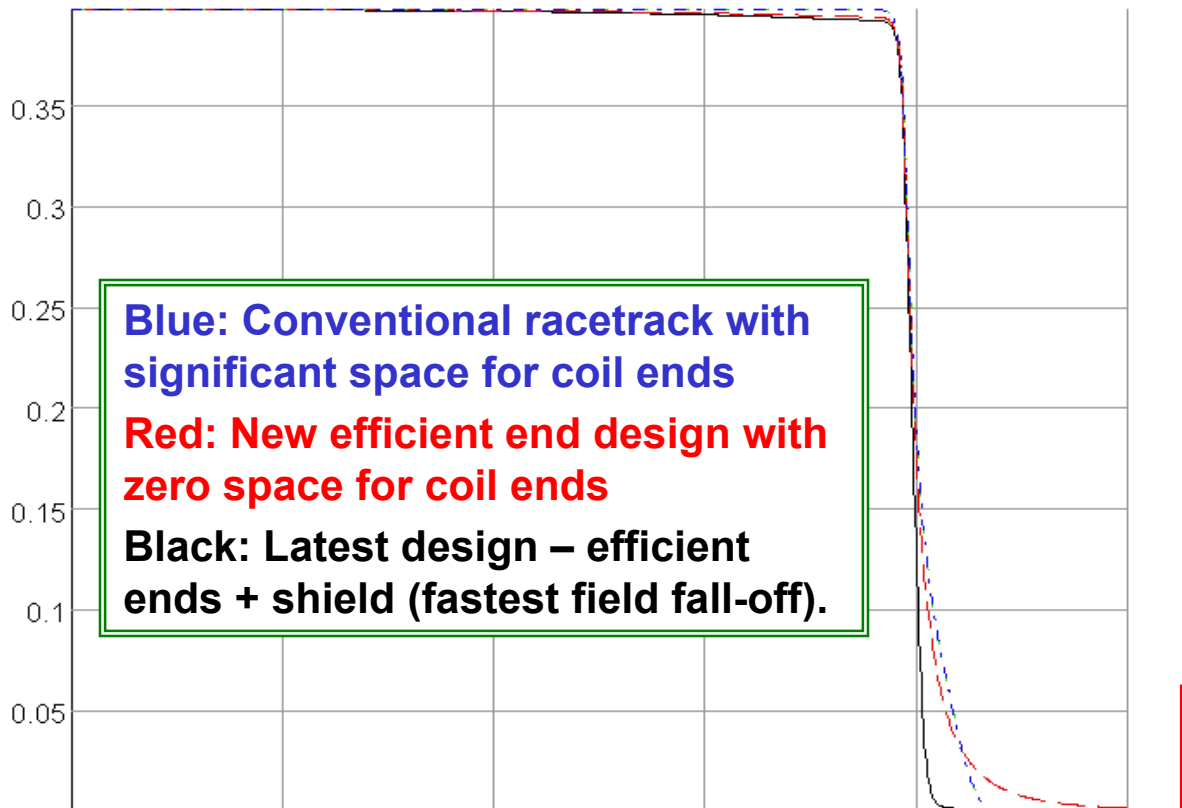


The goal is to match the integral transfer function of the 90 mm aperture dipole with that of 35 mm aperture dipole for the same current (number of turns are different in two).

Also compare the end field profile of the two magnets.

As expected, the field of 35 mm aperture dipole falls slower than the field of 90 mm aperture dipole. End harmonics in both apertures will be optimized.

Review of End Fields in Various Designs



X coord	50.0	52.2086223	58.8340983	69.875256	85.3301421	105.19602
Y coord	0.0	0.0	0.0	0.0	0.0	0.0
Z coord	8.0577E-12	332.099659	664.140567	996.063983	1327.81119	1659.3234
— Component: BMOD, Integral =	524.711552367817					
— Component: BMOD, Integral =	531.804875860282					
— Component: BMOD, Integral =	533.087048290844					
— Component: BMOD, Integral =	533.087048290844					

Length	mm
Magn Flux Density	T
Magn Field	A m ⁻¹
Magn Scalar Pot	A
Magn Vector Pot	Wb m ⁻¹
Elec Flux Density	C m ⁻²
Elec Field	V m ⁻¹
Conductivity	S mm ⁻¹
Current Density	A mm ⁻²
Power	W
Force	N
Energy	J

PROBLEM DATA
racetrk-only-6l.op3
TOSCA Magnetostatic
Nonlinear materials
Simulation No 1 of 1
2671597 elements
453160 nodes
3 conductors
Nodally interpolated fields
Activated in global coordinates

Field Point Local Coordinates
Local = Global

We can make attempt to match ends profiles of 35 mm and 90 mm aperture dipoles, if required.